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No. 680

IN THE

# Supreme Court of the United States

OCTOBER TERM, 1941

U. S. INDUSTRIAL CHEMICALS, INC.,
*Petitioner,*

*vs.*

CARBIDE AND CARBON CHEMICALS CORPORATION,
*Respondent.*

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FOURTH CIRCUIT

## BRIEF FOR PETITIONER

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## BRIEF FOR PETITIONER.

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### Opinions Below

The opinion of the Circuit Court of Appeals (R. Vol. II, pp. 173-187) is reported in 121 F. (2d) 665. The opinion of the District Court (R. Vol. I, pp. 3-22) is reported in 34 F. Supp. 813.

### Jurisdiction

The decree of the Circuit Court of Appeals which petitioner seeks to have reviewed was entered June 29, 1941 (R. Vol. II, p. 187). The petition for writ of certiorari was

filed on October 4, 1941, and was granted on November 10, 1941. The jurisdiction of this Court rests upon Section 240 (a) of the Judicial Code as amended by the Act of February 13, 1925, c. 229 (28 U. S. Code, Sec. 347).

## Questions Presented

The questions presented are:

(1) Can a patent for a process which includes a step asserted to be mandatory and described and claimed in the original patent as an essential feature of the patented invention be reissued to include a process which achieves the same result while dispensing with the step referred to?

(2) Does one who in good faith and at great expense completely develops a process which does not infringe an original patent, but which does infringe the broadened claims of a reissue thereof granted after the development work is complete but before the new process is put into commercial use, acquire intervening rights barring injunctive relief against commercial use of the process?

## Statute Involved

The reissue statute, R. S. Sec. 4916, is printed in full in the appendix hereto, page 55.

## STATEMENT OF FACTS

This is a suit in equity brought by respondent against petitioner in the United States District Court for the District of Maryland for alleged infringement of claims 8 and 9 of reissue patent 20,370, granted May 18, 1937, on an application for reissue filed September 25, 1936. The

reissue patent is founded upon original patent 1,998,878, for a "Process for the Production of Ethylene Oxide," granted April 23, 1935, on an application filed March 22, 1932. The patents were granted in the name of Theodore Emile Lefort, of Paris, France. They are based upon earlier French patents, the first of which was applied for on March 27, 1931 (R. Vol. I, p. 367).

The District Court held claims 8 and 9 of the reissue patent valid and infringed and entered the usual interlocutory decree (R. Vol. I, p. 3; 34 F. Supp. 813). On appeal to the Circuit Court of Appeals for the Fourth Circuit, the decree was affirmed (R. Vol. II, p. 173; 121 F. (2d) 665).

The case is here on writ of certiorari issued because of conflict between the decision of the Circuit Court of Appeals for the Fourth Circuit in this case and decisions of this Court and of the Courts of Appeals for other circuits.

## The Catalytic Oxidation Process

The several Lefort patents deal with oxidation by catalytic reaction. The chemical principles and reactions which must be understood for the purpose of dealing with this suit may be explained briefly and understood readily, and they are not the subject of substantial dispute.

There are many substances available for use whose utility and value are increased by oxidizing them, that is, causing one or more atoms of oxygen to unite with each molecule of the substance to be oxidized. With some substances this reaction of oxidation is a simple one which can be made to occur by merely bringing the oxygen and the substance to be oxidized into contact. With others the oxidation does not occur readily and special expedients must be employed to effect it.

One such special expedient is the utilization of a catalyst, a substance which merely by its presence causes a chemical union or reaction when the two substances are brought into contact under appropriate conditions in the presence of the catalyst, a union or reaction which would not occur under those conditions in the absence of the catalyst (R. Vol. II, pp. 4-5).

The patent in suit relates to a process of oxidizing ethylene gas by catalytic action to form ethylene oxide. One major use of ethylene oxide is to form an anti-freeze solution for cooling automobile engines, for which use it is better than alcohol because it does not evaporate (R. Vol. II, p. 4). The chemical formula of ethylene gas is $C_2H_4$ which indicates a molecule consisting of two atoms of carbon and four atoms of hydrogen. The chemical formula of ethylene oxide is $C_2H_4O$, representing the chemical union of one atom of oxygen with an ethylene molecule (R. Vol. II, pp. 3-4).

Prior to the patents involved in this suit, ethylene oxide in what might be called the hydrated form known as ethylene glycol was available commercially and was in use to some extent. It was made by an *indirect* procedure in which two or more chemical unions or reactions occur successively to derive liquid ethylene glycol from ethylene gas (R. Vol. II, pp. 5-8). Later, when the demand for ethylene oxide and ethylene glycol expanded as it did (R. Vol. I, p. 221), it became desirable to produce them by a less expensive procedure, and that led to the development of the process of *direct* oxidation with which we are here concerned.

The direct oxidation process has one drawback. In addition to the main reaction producing ethylene oxide, a side reaction whereby a portion of the ethylene is con-

verted to useless by-products, carbon dioxide and water, invariably occurs. In the degree to which the ethylene subjected to the process is used up in the formation of these waste products, the efficiency of the process is impaired. This undesirable side reaction is apparently inherent in the process and in practice has never been completely eliminated (R. Vol. II, pp. 11; 33; 41; 97; 104). By proper control of the oxidation, however, this undesirable side reaction can be held within economic limits.

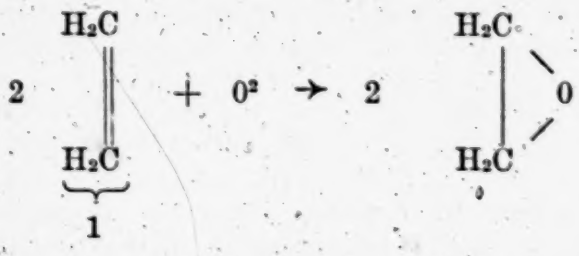
## The Original Lefort Patent

A copy of this patent is, for convenience, included in the appendix hereto at page 57.*

The specification opens with a concise statement of the invention (1/1/1-6):

> "This invention has for object a process for the production of ethylene oxide which mainly consists in subjecting ethylene *to the simultaneous action of the oxygen of air and of water,* in presence of a catalyzer and, if need be, of hydrogen."

The chemical formula expressing the oxidation of ethylene to ethylene oxide (1/1/11-15) is given as:




* References to the patents will be cited as: (1/1/1-6) i. e. page 1, column 1, lines 1 to 6. Throughout the brief, emphasis, unless otherwise noted, is ours.

The specification mentions first the optional use of hydrogen (1/1/7-9) and then refers at some length to the catalyzer, enumerating the metals and combinations of metals which may be employed (1/1/22—1/2/5). Since no issue relating to the role of either of these factors in the process is before the Court, these passages need not be dwelt upon.

The specification then proceeds (1/2/6-13) with some facts about the sources from which the three elements named as reactants in the introductory statement of the invention can be obtained and the form in which they may be used. It states:

> "The ethylene can be obtained from any source of supply: gas from coke ovens, hydrogenation of acetylene, dehydration of ethyl alcohol, and the like.
>
> Water can be admitted in the reaction vessel, either in the liquid state, or as steam.
>
> The oxygen can be oxygen of the air, this latter gas being introduced in the reaction."

As to the significance of the water introduced into the process the patentee says (1/2/14-18):

> "The efficiency of the reaction is increased by diminishing the $CO_2$ which is formed, by introduction, in this reaction, of a suitable quantity of water. A suitable volume of $CO_2$ can also be previously introduced in the reacting gases."

The $CO_2$ which the patentee expresses a purpose to diminish is the $CO_2$ formed in the course of the undesirable side reaction producing carbon dioxide and water referred to *supra* pages 4 and 5.

The specification refers again (1/2/30-43) to this undesired side-reaction, and discusses at greater length the

part which the introduction of water into the reaction chamber plays in that connection. It says:

> "Moreover, the applicant has found that the reaction giving $CO_2$ is, contrarily to previous belief, a reaction of oxidation independent from that giving ethylene oxide and from that giving aldehydes. From experiments effected by the applicant, it results that, if water is introduced in suitable quantity, the reaction is not only facilitated, as above stated, but, in addition, the reaction giving $CO_2$, probably by direct oxidation of ethylene according to the equation:
>
> $$C_2H_4 + 3O_2 = 2H_2O + 2CO_2$$
>
> is *checked*, owing, as is probable, to the partial pressure of water."*

The specification then goes on to say that the experiments referred to indicate that the side reaction producing the undesired $CO_2$ and water may be "completely checked" and the efficiency of the reaction producing ethylene oxide considerably increased if $CO_2$ is initially introduced into the reaction chamber in proper quantity along with the ethylene, air and water (1/2/44-51).

Then the specification, by way of example, sets forth three "modi operandi" for utilizing the patented process. In all three of the "modi operandi" described, each of the reactants named in the introductory statement of the invention, ethylene, the oxygen of air, and water, is specifically included, and in each of the three it is directed that

---

* This equation $C_2H_4 + 3O_2 = 2H_2O + 2CO_2$ indicates that the side reaction forms water ($H_2O$) as well as carbon dioxide ($CO_2$) and that whenever $CO_2$ is formed by the side reaction, a proportional amount of water is formed at the same time. Checking the side reaction to diminish the formation of carbon dioxide will likewise diminish the formation of water.

water shall be introduced into the reaction vessel along with the ethylene and air, either in the liquid state or as water vapor, *i. e.*, steam.

In *Modus operandi I* (2/1/5-25) a mixture of air and ethylene is compressed and then led, "together with hydrogen or not," into a reaction tube containing one of the catalyzers listed in the patent, and it is said that the reaction tube communicates with "a circulating pump *allowing to introduce water* under pressure." It is stated that (2/1/20-21):

> "The reaction will take place in this tube between ethylene, the oxygen of air, *and water.*"

In *Modus operandi II* (2/1/28-39) silver, one of the catalyzers enumerated, in powder form or in the form of a wire gauze, is introduced into the reaction tube, and after the tube has been suitably heated, a mixture of ethylene, air, *water vapor,* and hydrogen is caused to pass through it. The ethylene oxide so produced is separated from the gases issuing from the tube.

In *Modus operandi III* (2/1/41-49) a silver colloid is introduced in a high pressure tube which has been *filled with water.* Pure ethylene under pressure is then dissolved in the water. The tube is then heated and air and hydrogen are slowly introduced until all of the ethylene is converted into ethylene oxide.

The patentee then points out that from the ethylene oxide produced according to the processes indicated above, it is possible to obtain certain derivatives of ethylene oxide including ethylene-glycol (2/1/50-59).

The specification concludes with another statement dealing with the importance to the attainment of the desired result of introducing into the reaction vessel a suitable

amount of water either in the liquid state or as steam. The statement is (2/2/1-5):

> "The experiments effected by the applicant have shown that, in presence of the catalyzers indicated, water, in the form of steam or not, considerably promotes the reaction ensuring the production of ethylene oxide."

Thus, as disclosed in the specification of the original patent, the invention is a process for the production of ethylene oxide which consists broadly in subjecting ethylene to the simultaneous action of oxygen, which can be the oxygen of air, *and water,* which has been *added* to the reaction vessel either in the liquid state or as steam, or mixed with the ethylene and oxygen in advance, in the presence of certain named catalysts placed in a reaction tube or chamber in which the temperature is maintained within a specified range.

Certain permissible variations of the process are disclosed in the specification. These alternatives relate to (1) the admission of hydrogen to the reaction chamber along with the ethylene, air and water (1/1/7-9); (2) the wide range of pressures at which the operation may be conducted (1/1/16-20; 1/2/19-21; 1/2/51-54); (3) the wide range of temperatures within the reaction chamber which may be employed (1/1/20-21); (4) the wide variety of catalysts which may be used (1/1/22-1/2/5; 1/2/22-30); and (5) the introduction of $CO_2$ into the reacting gases (1/2/17-18; 1/2/44-51). No variation with respect to the introduction of water into the reaction chamber is suggested.

The original patent contains seven claims. All of them correspond to the subject matter of invention set forth in the specification. All seven specify a process for the pro-

duction of ethylene oxide consisting in subjecting ethylene to the simultaneous action of *oxygen and water* in the presence of a catalyst. In claims 4 to 7, the water is stated to be in the form of steam, and in claims 6 and 7 it is stated that hydrogen is also admitted.

From the foregoing description, it is evident, and the Court below so held, that the process contemplated in the original patent is one in which the introduction of water into the reaction chamber along with the ethylene and oxygen is mandatory, the introduction of water being described, not as an optional procedure, but as a step in the process always to be taken (R. Vol. II, p. 176).

## The Circumstances Leading to the Reissue Application

The original Lefort patent was issued April 23, 1935. It was assigned by Lefort, like the antecedent French patents, to a French company named Société Francaise de Catalyse Généralisée, referred to hereinafter as the French Company. Respondent, Carbide & Carbon Chemicals Corporation, obtained title to the original patent by purchase from the French Company, arrangements for the purchase being concluded in March or April, 1936 (R. Vol. I, p. 269; Vol. II, p. 61).

Simultaneously with this purchase, respondent became dissatisfied with what had been secured as the subject matter of the original patent. Respondent's dissatisfaction arose as the result of a study of the patent by Emory P. Boynton, one of respondent's patent attorneys, who had been asked to say "whether or not the patent would cover the process disclosed in it" (R. Vol. I, p. 268).

In February or March of 1936, just prior to Mr. Boynton's study of the patent, an investigation of the oxidation

of ethylene in accordance with the disclosure of the original Lefort patent was undertaken by respondent's technical staff (R. Vol. I, pp. 260-61, 263). The first series of tests conducted were failures in the sense that no ethylene oxide was produced (R. Vol. I, p. 265). Experimental work was continued, however, and as a result it was concluded that ethylene oxide could be produced on an industrial scale by a process *which does not involve the addition of water in any form* to the mixture of ethylene and air passed through the reaction chamber containing the catalyst, but instead consists in passing only ethylene and air over the catalyst (R. Vol. II, p. 60; Vol. I, pp. 262-3). Mr. Boynton's study of the patent began after the technical staff had obtained "positive results" and was made with some knowledge of this experimental work (R. Vol. I, pp. 268-9 and 271).

Mr. Boynton's study of the patent brought him to the conclusion that Lefort should have obtained "far broader claims" in his patent. He said "it was apparent that because of the way that the French solicitor had prepared the original U. S. Application from these French patents that it would be virtually impossible to claim the invention broadly so as to cover it *whether or not water was even present, added or introduced or formed.*" He concluded that such "far broader claims" might be obtained by a reissue of the original patent (R. Vol. I, pp. 275-276).

Respondent communicated these conclusions to Lefort, and Mr. Boynton prepared and transmitted to Lefort in Paris, France, an application for reissue of the original patent, including a form of oath to be made by Lefort in support of the application.* Lefort executed the papers

* The assignment agreement transferring patent 1,998,878 to respondent contained a covenant binding the French company to sign all papers requisite for obtaining a reissue of the patent (R. Vol. I, p. 445).

sent to him, and they were filed in the Patent Office on behalf of respondent on September 25, 1936, as application Serial No. 102,613 (R. Vol. I, pp. 268-276 and 309 *et seq.*).

## The Reissue Application and Oath

The oath made by Lefort in support of the reissue application as originally filed sets forth that respondent, through its technical representatives and patent counsel, had observed and ascertained certain defects in the original patent. These defects, according to the oath, include the following (R. Vol. I, p. 322):

> "(a) The specification and claims do not emphasize sufficiently clearly that the process of oxidizing ethylene to ethylene oxide is operable *whether or not water is present*, and that the presence of water in the reaction is but one preferred embodiment of the invention * * *."

The defects, it was said, arose and occurred (R. Vol. I, p. 323):

> "through failure of the applicant and his attorney to appreciate fully the relation of the claims to the preferred scope of the invention, and failure of applicant to instruct adequately his attorney in the fullest benefits and application of his invention, namely, in the production of ethylene oxide by oxidation of ethylene in the presence of catalysts *with or without the inclusion of water in the reaction.*"

## The Proceedings in the Patent Office

The Patent Office Examiner to whom the reissue application was referred allowed the seven claims of the original patent which were retained in the reissue application in substantially their original form (R. Vol. I, p. 326), but all

of the new and broader claims were rejected by the Examiner as being "without patentable merit" in view of certain references cited. In addition to the rejection on that ground, the Examiner said (R. Vol. I, p. 325):

> "It is noted that in presenting the original case and also in distinguishing over this reference in the original applicant finally restricted the claims to specified catalyst and indicated that such catalysts *and the presence of steam* enabled increased yields. In other words, the case was presented as an improvement over prior known processes of oxidation of ethylene, so as to increase the yield of ethylene oxide. It appears to be too late to now urge that applicant is the pioneer inventor of processes of oxidizing ethylene."

Following this rejection, on March 13, 1937, a private conference was held with the Examiner (R. Vol. I, p. 337), and on April 10, 1937, thereafter, respondent filed a new specification differing considerably from the one previously filed (R. Vol. I, p. 333) and another supporting oath by Lefort (R. Vol. I, p. 338). In contrast with the statement in the first reissue oath that the defect of the original patent lay in the failure to emphasize clearly that the process was operable "*whether or not water is present*" and "*with or without the inclusion of water in the reaction*", the second oath asserts that the defect of the original patent consists in (R. Vol. I, p. 340):

> "the failure more clearly to point out that *a substantial quantity of water is inherently present in the reaction tube* due to the substantial independent oxidation of ethylene to carbon dioxide and water, the failure to make clearer that the addition of water or carbon dioxide or both *to augment the water and carbon dioxide inherently and independently formed,* as well as the addition of hydrogen, are merely supplemental features still within the scope of the real invention * * *."

This second oath goes on to explain these failures as follows (R. Vol. I, p. 342):

> "Deponent through inadvertence failed to stress to his attorney the point that a substantial quantity of water was *inherently present* by reason of independent complete oxidation of some of the ethylene giving water and carbon dioxide, and that *any augmentation* of this water by the direct addition of water to the reaction zone might be practiced or omitted as desired."

The thought behind this statement in the supplemental oath—that the object of the direction to introduce water into the reaction chamber was to *augment* the quantity of water existing there by reason of the side reaction—is quite the reverse of the thought of the original patent, which specifically states that one of the functions of the water introduced into the reaction chamber is, not to *augment* the $CO_2$ and water formed by the side reaction, but to *diminish* them by checking the side reaction or eliminating it completely (1/2/14-18; 1/2/30-51; *supra*, pp. 6 and 7).

By the new specification filed as above stated along with this second oath, the claims which had been rejected by the Examiner were withdrawn and two new claims were presented, numbered 19 and 20 (R. Vol. I, p. 335). Those two claims, with one minor change, are claims 8 and 9 of the reissue patent here in suit (R. Vol. I, pp. 363-365).

## The Reissue Specification

A copy of the reissue patent is also included in the appendix hereto at page 59.

The rewritten description of the process which appears in the reissued patent begins with a summary statement about the invention sought to be secured (1/1/1-8):

"This invention provides a specific and novel process for making ethylene oxide. It essentially consists in causing ethylene *to combine directly with molecular oxygen* at temperatures of about 150° to about 400° C. in the presence of a surface catalyst which favors the oxidation of ethylene to ethylene oxide under these conditions."

The specification then states that the process can be carried out at atmospheric pressure or at pressures above or below atmospheric pressure; and that the chemical reaction produced by the process is one in which the direct addition of a single oxygen atom to the ethylene molecule occurs without the formation of significant amounts of other oxygenated compounds such as aldehydes (1/1/8-17).

This is followed by the chemical expression of the two reactions which occur in the process, the main reaction which produces ethylene oxide and the side reaction which produces carbon dioxide and water (1/1/17-25). These equations of the reissue patent differ in form from the equations appearing in the original patent at 1/1/11-15 and 1/2/41 respectively, but they have the same chemical significance.

The specification next states that ethylene from any desired source may be used; and that the oxygen employed can be oxygen of the air, and can be conveniently mixed with the ethylene prior to the reaction (1/1/26-32).

The specification then makes the sole reference to the introduction of water to the reaction chamber contained in the reissue patent (1/1/33-42):

"The oxidation of ethylene takes place with a giving off of heat, and it is, of course, desirable to maintain the temperature of the zone of reaction within the range specified. This can be facilitated

by suitable dilution of the reaction gases, such as that accomplished by the use of air as the source of oxygen, *and some water or carbon dioxide in addition to that formed can be admitted to the mixture in the reaction zone if desired.* Hydrogen may be similarly added."

The specification then proceeds to set forth a mode of operating the process. The procedure described is in substitution for the three *modi operandi* of the original patent and approximates most closely *Modus operandi I* though it differs from all three in that no water is added to the reaction chamber (1/1/43—1/2/3):

> "The process can be conveniently conducted by passing a mixture containing air and ethylene through a tube, for example, of silica or of a material capable of withstanding high pressures, within which is placed such a surface catalyst as one composed of silver in finely divided form, and which may be disposed within the tube on a supporting material, or in other known ways. The temperature of the reaction zone is maintained between about 150° and about 400° C., for example, at about 200° C., and the issuing products from the tube contain ethylene oxide, carbon dioxide and water without objectionable aldehydes. The ethylene oxide can be recovered in any suitable way, preferably in liquid form by condensation or solution."

After a paragraph (1/2/4-11) referring to the catalyst, the new specification concludes as follows (1/2/12-19):

> "In any case, the ethylene and oxygen are thus reacted simultaneously at the temperatures set forth in the presence of a surface catalyst and of water, and the process is conducted to produce ethylene oxide as a direct product in substantial and economic amount. The ethylene oxide can be recovered by known methods, and it may be further reacted to

form ethylene glycol or derivatives of ethylene glycol."

*Claims 8 and 9 of the Reissue*

The reissue patent contains nine claims. Claims 1 to 7, except for slight changes in form, are identical with the seven claims of the original patent. They are not charged to be infringed by petitioner's process. Claims 8 and 9 are the new claims obtained by the reissue and infringement is alleged as to them only.

These claims 8 and 9 are broader than the claims of the original patent. They include no reference to the introduction of water into the reaction chamber, and no reference to "subjecting ethylene to the simultaneous action of the oxygen of air and of water" as stated in the original description and in all of the other claims. They conform to the changed description of the reissue that water is to be introduced only "if desired."

The first step of the process defined in claims 8 and 9 of the reissue is "forming a mixture containing ethylene and molecular oxygen." This mixture may be a mixture of ethylene and air, as appears in the reissue specification (1/1/29-31), or of ethylene and dry oxygen (R. Vol. II, p. 93). The inclusion of water as one of the reacting ingredients entering the reaction chamber is not required.

It is also stated in claims 8 and 9 that the catalyst to be used is one which favors the reaction "in the presence of water." This limitation, however, does not require that water be introduced into the reaction chamber along with the ethylene and air as one of the ingredients which are to react and combine in the presence of the catalyst. It is fulfilled by the presence of that small quantity of water

produced by the side reaction forming carbon dioxide and water.

Thus claims 8 and 9 of the reissue patent are broad enough to cover, and do cover, a process from which the step of introducing water into the reaction chamber has been omitted. This is the interpretation placed upon these claims by respondent (R. Vol. I, p. 281), and it is the interpretation which they must bear in order to sustain the charge of infringement.

The Court below found as fact that the reissue patent does not contemplate the voluntary introduction of water into the reaction chamber as a necessary step in the procedure and that claims 8 and 9 "seem to negative clearly any such step" (R. Vol. II, pp. 176, 177).

## Petitioner's Process

Petitioner is engaged in the commercial production of ethylene glycol in its manufacturing plant at Baltimore, Maryland. As one of the steps in such manufacture, ethylene oxide is produced by passing a gaseous mixture of ethylene and the constituents of atmospheric air (including a substantially normal water vapor content, R. Vol. I, p. 279) through a chamber containing a catalyst consisting of silver disposed upon a carrier of aluminum oxide bonded by a fusion process, the mixture being passed continuously through the chamber in intimate contact with the catalyst during an extended period of time. Throughout the operation the temperature within the chamber is maintained between about 150° and about 400° C. As a result, ethylene oxide is produced in substantial amount, and the resulting gaseous mixture containing the ethylene oxide is passed out of the chamber continuously during the operation.

Thereafter, the ethylene oxide is dissolved out of the mixture into an acidified aqueous medium, and is reacted in the solution to form ethylene glycol (R. Vol. I, pp. 279-280).

Petitioner's process was developed as a result of research and development work which began in January, 1934, and was carried on continuously through the next three years. Petitioner's researchers had knowledge of the Lefort French patents and the original U. S. patent and the limitations contained therein during this work (R. Vol. I, pp. 196; 223). Through the first two years of this period, the research covered catalytic operations both with and without water. Toward the end of 1935, the idea of introducing water into the reaction chamber along with the ethylene and oxygen was definitely discarded (R. Vol. I, pp. 222-4).

By the end of 1936, a commercial process had been developed and in the spring of 1937 an application for patent covering that process was filed and a patent has since issued thereon (R. Vol. I, pp. 217; 224-5).

In April, 1937, plans for a large pilot-plant were started and at the same time estimates for a commercial plant were undertaken. The pilot-plant was built and went into operation in the middle of 1937. After extended operation of this pilot-plant, construction of petitioner's commercial plant near Baltimore, Maryland, was undertaken in the middle of 1938 and that plant was completed and put into operation on May 9, 1939, and has been in continuous successful operation ever since (R. Vol. I, pp. 217; 226).

Petitioner's expenditures upon the research and development work from its inception up to September 25, 1936, when the application for reissue of the patent in suit was filed, totaled about $132,000, and its further expendi-

tures on this research up to May 18, 1937, when the reissue patent was granted, totaled $19,000, an aggregate of $151,000 (R. Vol. I, p. 226).

The process so evolved by petitioner is within the description of the reissued patent and is within the broad claims 8 and 9 in suit as respondent maintains they should be interpreted. It is *not* within the description of the original patent, nor the claims of that patent, nor claims 1 to 7 of the reissue, and respondent has never asserted infringement of any of those claims."

## The Proceedings in the Courts Below

In the Courts below, petitioner challenged the validity of claims 8 and 9 of the reissue upon the ground which is here for review, namely, that those two claims are not "for the same invention" as the original patent within the meaning of the Reissue Statute, R. S. 4916.

Petitioner also maintained that respondent is estopped from asserting claims 8 and 9 of the reissue against petitioner, even if those claims are valid, because of intervening rights acquired by petitioner with respect to the accused process prior to the date of the reissue.

The District Court rejected these defenses. In deciding the question of same invention, Judge COLEMAN concluded that "with respect to water, the specifications of the original patent are not *essentially* different from those in the reissued patent" (R. Vol. I, p. 9). Relying upon expert testimony as to the results obtained by the processes disclosed in the two patents, which he said "in the last analysis, should control," Judge COLEMAN found that "whether the addition of water be considered as manda-

tory or as optional" in the original patent, one skilled in the art, following the teachings of that patent, will obtain "the same result" that will be obtained if he follows the teachings of the reissued patent, and that this fact "conclusively demonstrates that there is no variance between the subject matter of the original and the reissued patent" (R. Vol. I, p. 10).

Judge COLEMAN made formal findings (R. Vol. I, p. 24) as follows:

> "7. There is no variance between the invention described in the specifications and claims of the original patent and in the specifications and claims 8 and 9 of the reissued patent in suit.
>
> 8. With respect to water, the specifications of the original patent are not essentially different from those in the reissued patent. Professor Arthur B. Lamb, testifying on behalf of the plaintiff, has satisfied the Court, through his very clear exposition of the character and results of his laboratory tests, that one skilled in the art, following the teachings of the original patent, will be successful in producing what that patent calls for, and in obtaining such result whether the addition of water be considered as mandatory or as optional, and that he will obtain the same result if he follows the teachings of the reissued patent in suit. In other words, what Professor Lamb accomplished by following the original patent proves not only the adequacy of its disclosure as to how to carry out the process successfully, but, in addition, conclusively demonstrates that there is no variance between the subject matter of the original and the reissued patent. This testimony is confirmed by the testimony of Professor Frazer, the inter-partes neutral witness, and also by that of Professor Stevenson and Dr. Curme, witnesses for the plaintiff."

The Court of Appeals affirmed the decree of the District Court (R. Vol. II, p. 173; 121 F. (2d) 665). In so doing, however, the Court found on a comparison of the specifications and claims of the two patents that the original patent describes, as the invention intended to be secured by it, a process in which the voluntary introduction of water into the reaction chamber is a mandatory step always to be taken, whereas the invention covered by claims 8 and 9 of the reissued patent includes a process in which the voluntary introduction of water into the reaction chamber is omitted.

The Court of Appeals made a "verbal analysis" of the specification of the original patent and stated its view as to the content of that patent as follows (R. Vol. II, p. 176):

> "We are convinced that this original patent contemplated the voluntary introduction of water into the reaction-chamber, not as an optional procedure, but as a step that would always be taken. The verbal analysis shows that, in the original patent, literally there is 'Water, water, everywhere'. Nor is it water developed as a by product, but it is water voluntarily introduced into the tube to bring about the desired reaction. * * * Some study of chemical history and literature, as these existed at the time of Lefort's labors, convinces us even more strongly of the truth of the conclusion that the voluntary introduction of water was a mandatory provision of the original Lefort patent."

The Court of Appeals then made a similar analysis of the specification of the reissue patent and stated its conclusion as to that as follows (R. Vol. II, p. 176):

> "It seems quite clear, on the other hand, that the reissue patent does *not* contemplate the voluntary introduction of water into the reaction-chamber as a

necessary step in the procedure." (Emphasis by the Court.)

The Court of Appeals then stated its further conclusion, derived from its findings as set forth in the two foregoing quotations, as follows (R. Vol. II, p. 177):

> "*there is a difference* here in that the original patent contemplated the voluntary introduction of water into the reaction-chamber (distinguished from the mere formation of water during the course of the reactions) as a step that would always be taken in the procedure therein set out, while Claims #8 and #9 contain no such requirement, and indeed seem to negative clearly any such step." (Emphasis and parenthesis by the Court.)

Having thus come to the conclusion that "there is a difference" between the original and the reissued patents on a comparison of their specifications and claims, the Court of Appeals then turned to the same line of testimony relied on by the District Court, the comparison of the *results* obtained by following the teachings of the two patents.

Referring to its finding of difference between the two patents, the Court said (R. Vol. II, p. 177):

> "Is this difference vital, essential, substantial, material? Judge Coleman answered this question categorically in the negative, in his Findings of Fact #7 and #8. Under Civil Rules of Federal Procedure, Rule 52(a), we can set aside these findings if, but only if, in our opinion the findings are 'clearly erroneous.'"

The Court discussed this issue at length and, like the District Court, rejected the defense of "same invention" on the strength of expert testimony to the effect that the dif-

ference which it had found to exist between the patents was not "vital, essential, substantial, material" from a technological point of view since the same ultimate result, namely, the production of ethylene oxide, is attained by both the process described in the original patent and the different process described and claimed in the reissue patent (R. Vol. II, pp. 180-181).

The defense of intervening rights was overruled by both of the courts below on the ground that petitioner's activity prior to the reissue was confined to experimental and development work and that the sum spent in this work was relatively small in comparison to the sums later expended in the erection and operation of petitioner's commercial plant (R. Vol. II, pp. 185-186).

## Specification of Errors to Be Urged

The court below erred:

1. In failing to hold that claims 8 and 9 of the reissue patent in suit are invalid because they are not for the "same invention" as the original patent;
2. In failing to hold that injunctive relief against petitioner's use of its process is barred by petitioner's intervening rights.

## Summary of Argument

The reissue statute has repeatedly been interpreted by this Court as rendering invalid reissue claims for mechanism or processes neither claimed nor described in the original patent as the invention intended or sought to be covered thereby. Claims 8 and 9 of the reissue in suit do cover

a process additional to and different from that described in the original patent as the process intended or sought to be covered thereby, and are therefore invalid.

Within the generality of the foregoing and as a specific instance thereof, when an original patent describes the machine or process sought to be secured thereby as one in which a certain element or step is mandatory, and a reissue of the patent describes that element or step as optional and contains broader claims covering the machine or process with that element or step omitted, such a reissue is invalid as to those broader claims as a matter of law. The original patent involved in this suit describes a process in which the introduction of water along with certain other ingredients into a chamber to participate in a reaction therein is a mandatory step and the reissue of that patent describes the process as one in which the introduction of water is an optional or permissive step and contains broader claims covering the process with the step of introducing water to the reaction chamber omitted. These broader claims, we submit, are therefore invalid.

Under the doctrine of intervening rights, we contend that one who in good faith has expended time, effort and money in the development of a process which does not infringe an original patent but does infringe the broadened claims of a reissue thereof granted after the development work is complete but before the process has been put into commercial use, is entitled to use the process he has developed free from the enlarged monopoly of the reissued patent.

## ARGUMENT

**1. Claims 8 and 9 of of the reissue patent in suit are invalid because they are not for the same invention as the original patent.**

### The Legal Principles Involved

The reissue statute, by its terms, limits the authority of the Commissioner of Patents to the reissuing of a patent "*for the same invention*" as that patented by the original patent. The statute emphasizes this requirement by providing that "no new matter shall be introduced into the specification" of the reissue. The authority granted by the statute being thus limited, a reissue patent is invalid where it appears that the reissue is not "*for the same invention.*" *Seymour* v. *Osborne,* 11 Wall. 516, 544-6; *Powder Co.* v. *Powder Works,* 98 U. S. 126; *Mahn* v. *Harwood,* 112 U. S. 354, 359.

The requirement that a reissue patent must be "for the same invention" has been in all the reissue statutes,* and the phrase, as it has appeared in the various statutes, has been before this Court for interpretation in numerous cases.

It has been determined that the requirement that a reissue patent must be "for the same invention" does not mean that the subject matter *claimed* in the reissue must be identical with that *claimed* in the original patent. Thus, a reissue patent containing a broader claim than the original may properly be granted. *Topliff* v. *Topliff,* 145 U. S. 156.

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* See discussion in *Parker & Whipple Co.* v. *Yale Clock Co.,* 123 U. S. 87, 96-7.

Also, the reissue may properly contain a narrower claim than the original. *Miller* v. *Brass Co.*, 104 U. S. 350, 353.

But it is settled that, in any event, by reason of the statutory restriction under consideration, a reissue patent must be confined to what appears as the invention which the patentee *attempted to cover* by the original patent, the "invention intended to have been secured" by the original patent, the "invention which the original patent was intended to cover." *Powder Co.* v. *Powder Works*, 98 U. S. 126, 138; *Parker & Whipple Co.* v. *Yale Clock Co.*, 123 U. S. 87, 99; *Flower* v. *Detroit*, 127 U. S. 563, 571; *Corbin Cabinet Lock Co.* v. *Eagle Lock Co.*, 150 U. S. 38, 43. It has been determined that such an intention or attempt does not appear when the additional matter embraced by the claims of the reissue is *not disclosed* in the original patent, *Clements* v. *Odorless Apparatus Co.*, 109 U. S. 641, 647; *Coon* v. *Wilson*, 113 U. S. 268, 277; *Gardner* v. *Herz*, 118 U. S. 180, 192-3; *Ives* v. *Sargent*, 119 U. S. 652, 662-3; *Hartshorn* v. *Saginaw Barrel Company*, 119 U. S. 664, 675; *Parker & Whipple Co.* v. *Yale Clock Co.*, 123 U. S. 87, 103-4; *Flower* v. *Detroit*, 127 U. S. 563, 569-72; *Electric Gas Co.* v. *Boston Electric Co.*, 139 U. S. 481, 501; *Freeman* v. *Asmus*, 145 U. S. 226, 239; *Huber* v. *Nelson Mfg. Co.*, 148 U. S. 270, 291-2; *Olin* v. *Timken*, 155 U. S. 141, 147, and that it will not avail the patentee in such case that the new matter covered by the reissue was actually within his knowledge at the date of application for his original patent. *Powder Co.* v. *Powder Works*, 98 U. S. 126, 138; *Manufacturing Co.* v. *Ladd*, 102 U. S. 408, 413; *Huber* v. *Nelson Mfg. Co.*, 148 U. S. 270. Similarly, decisions of this Court make it clear that the mere fact that an invention might have been claimed in the original patent, because it was suggested or indicated in the specification, is not enough

to warrant its claim in the reissue. They hold it *must also appear from the face of the patents* that what is covered by the reissue patent was *intended* to have been covered and secured by the original. *Parker & Whipple Co.* v. *Yale Clock Co.*, 123 U. S. 87, 99; *Flower* v. *Detroit*, 127 U. S. 563, 571.

The whole subject of the interpretation of the phrase "for the same invention" was reviewed and settled by this Court in *Parker & Whipple Co.* v. *Yale Clock Co.*, 123 U. S. 87.* In that case the various reissue statutes and the prior decisions dealing with the phrase were considered, and the conclusion was reached that the requirement that a reissue must be "for the same invention" means that a reissue must be confined to the invention which appears on examination of the original patent to be the invention intended to be covered or secured by the original patent (pp. 99, 102); or, stated in the words of the Court, to satisfy the requirement of the statute it must appear "from a comparison of the two patents, that the original patent embodied, as the invention intended to be secured by it, what the claims of the reissue are intended to cover" (p. 99). In disposing of the case before it, the Court said (p. 95):

> "The appellants contend that the first eight claims of the reissue do not specify any invention which is not contained in the clock described in the original patent and embodied in the model originally deposited in the Patent Office, and that the drawings of the original and of the reissued patent are substantially the same. On these premises, it is argued

* The specific facts of the *Parker & Whipple* case vary widely from those of the instant case. Cases presenting fact situations analogous to the instant case and applying the rule of the *Parker & Whipple* decision thereto are discussed *infra* pages 35 to 41.

for the appellants, that it is lawful to include in the claims of a reissue whatever is suggested, or substantially indicated, in the specification, model or drawings of the original patent, if the applicant was the original and first inventor thereof, and that such a reissue will, therefore, be for the same invention as that of the original patent.

"Expressions in some opinions of this court, wrested from their context and interpreted in a different sense from that in which they were used, are cited to support these views; but the language of the court on the subject *has steadily been to the contrary,* and, as the question arises so distinctly in this case, and some misapprehension exists in regard to it, it seems proper to discuss it with some fulness."

The Court proceeded to review the statutes and several decisions, including that in *Seymour* v. *Osborne* above cited, and then continued (pp. 98-99):

"In these extracts from the opinion it is seen that the court adheres strictly to the view, that, under the statute, the Commissioner has no jurisdiction to grant a reissued patent for an invention substantially different from that embodied in the original patent, and that a reissue granted not in accordance with that rule is void. In what is there said about redescribing the invention, and about including in the new description and new claims what was suggested or indicated in the original specification, drawings or patent office model, it is clearly to be understood, from the entire language, that the things so to be included are only the things which properly belonged to the invention as embodied in the original patent; *that what that invention was is to be ascertained by consulting the original patent;* and that, while the new description may properly contain things which are indicated in the original specifica-

> tion, drawings or patent office model, (though not sufficiently described in the original specification,) it does not follow that what was indicated in the original specification, drawings or patent office model is to be considered as a part of the invention, *unless the court can see, from a comparison of the two patents, that the original patent embodied, as the invention intended to be secured by it, what the claims of the reissue are intended to cover.*"

This Court has never departed from the rule announced in the *Parker & Whipple* case and has referred to that case with approval in many subsequent decisions, including *Matthews* v. *Ironclad Mfg. Co.*, 124 U. S. 347, 351; *Hoskin* v. *Fisher*, 125 U. S. 217, 223; *Yale Lock Co.* v. *James*, 125 U. S. 447, 464; *Flower* v. *Detroit*, 127 U. S. 563, 571; *Freeman* v. *Asmus*, 145 U. S. 226, 240; and *Corbin Cabinet Lock Co.* v. *Eagle Lock Co.*, 150 U. S. 38. In this last case, the Court said (pp. 42-3):

> "It is *settled* by the authorities that to warrant new and broader claims in a reissue, such claims must not be merely suggested or indicated in the original specification, drawings, or models, but it must further appear from the original patent that they constitute parts or portions of the invention which were *intended or sought to be covered or secured by such original patent.*"

*Identity is to be Determined by Comparison of the Patents*

It is thoroughly established that the issue of identity between what the inventor intended and attempted to cover in the original patent and what is claimed in the reissue patent is to be determined *by a comparison of the two patents.* Extrinsic evidence, except such as is needed to explain terms of art or to apply the descriptions to the subject matter, is excluded. The attempt of the inventor to secure patent pro-

tection for an invention covered by a reissue must be discoverable in the specification and drawings or model of the original patent. The cases in which this rule has been accepted and applied are in considerable number and include the following.

The rule was clearly stated in the *Parker & Whipple Co.* case discussed in our brief, *supra,* pages 29 and 30.

In *Seymour* v. *Osborne,* 11 Wall. 516, the Court said at pages 545-6:

> "Whether a reissued patent is for the same invention as that embodied in the original patent or for a different one is a question for the court in an equity suit to be determined as a matter of construction, *on a comparison of the two instruments,* aided or not by the testimony of expert witnesses, as it may or may not appear that one or both may contain technical terms or terms of art requiring such assistance in ascertaining the true meaning of the language employed."

In *Heald* v. *Rice,* 104 U. S. 737, the Court said on page 749 that this issue of "same invention" is one of "pure construction, and not of evidence; and consequently is matter of law for the court".

In *Ball* v. *Langles,* 102 U. S. 128, the Court said, page 130:

> "Accordingly, this court has repeatedly held that if, *on comparing a reissue with its original,* the former appears on its face to be for a different invention from that described or indicated in the latter, it must be declared invalid."

In *Freeman* v. *Asmus,* 145 U. S. 226, discussing whether a reissue was for the same invention as the original patent, the Court said (p. 239):

> "There is nothing *in the original specification* which indicates that any such claim was intended to be made in the original patent;"

See also the quotation *supra*, page 30, from the decision in the *Corbin Cabinet Lock Co.* case; and *Russell* v. *Dodge*, 93 U. S. 460, 464; *Garneau* v. *Dozier*, 102 U. S. 230, 231; *Manufacturing Co.* v. *Ladd*, 102 U. S. 408, 409; *Clements* v. *Odorless Apparatus Co.*, 109 U. S. 641; *Hoskin* v. *Fisher*, 125 U. S. 217, 221; *Dunham* v. *Dennison Mfg. Co.*, 154 U. S. 103.

## Application of Established Principles to This Case

What appears from a comparison of the reissue patent and the original patent in this case (*supra*, pp. 5-10 and 14-18) may be summarized by the following quotations from the opinion of the Circuit Court of Appeals:

1. "the voluntary introduction of water was a mandatory provision of the original Lefort patent" (R. Vol. II, p. 176).
2. "the reissue patent does *not* contemplate the voluntary introduction of water" (R. Vol. II, p. 176).
3. "*there is a difference* here in that the original patent contemplated the voluntary introduction of water * * * as a step that would always be taken * * * while Claims #8 and #9 [of the reissue] contain no such requirement, and indeed seem to negative clearly any such step" (R. Vol. II, p. 177).

These findings are fully supported by an analysis of the patents.

The original patent contains no reference whatever, either in the specification or in the claims, to a process in

which the mixture subjected to contact with the catalyst in the reaction chamber is a mixture of ethylene and air only, nor any reference to a process in which water is not introduced into the reaction chamber (*supra,* pp. 5-10).

As to many of the individual items which make up the complete process, the original specification describes permissible alternatives, omissions and variations. But, though so much of the specification consists of a description of possible variations of the indicated procedure, it does not include any mention of or reference to a procedure in which no water is introduced into the reaction chamber along with the ethylene and oxygen, or in which no water is present in the reaction chamber other than that formed by the unavoidable side reaction (*supra,* p. 9).

Also, the claims define the process in terms which give appropriate recognition to the described alternatives, but the use of ethylene, oxygen *and* water either in the form of liquid or as steam, is called for by every claim (*supra,* pp. 9-10).

The instant case consequently is not one in which the process covered by the reissue is poorly or imperfectly stated in the original patent and in which the issue of intention is close. It is a case in which lack of intention is manifest since the process in question is not mentioned or referred to *at all* either in the specification or in the claims of the original patent.

The reissue simply omits from the process described and claimed in the original patent a process step—the introduction of water into the reaction chamber—made mandatory in the process originally claimed and intended to be patented. And so the Court below found. Had the lower Court applied to these facts this Court's interpretation of the statutory requirement, it could only have concluded that the

reissue patent was invalid. Instead, the Court of Appeals rested its decision upon an appraisal of the difference it had found to exist between the process intended to be secured by the original patent and the process covered by Claims 8 and 9 of the reissue patent, concluding that this difference was not "vital, essential, substantial or material" from the standpoint of technological results, and that therefore the reissue claims were valid.

The difference between the two patents found to exist by the Court of Appeals was not considered by that Court from the standpoint of the monopoly sought by the patentee in the original patent and obtained by his assignee in the reissue. Instead, it appears to have been considered only from the standpoint of the technological results obtained. The Court resolved the issue thus artificially created in favor of the respondent and thereon held the reissue patent valid.

The basis asserted by the Court below for this decision was the conclusion of respondent's expert witnesses that the difference between the two processes is not significant from a scientific point of view* since the same technological result can be obtained whether the method followed is that of the process disclosed in the original patent or that of the process disclosed and claimed in the reissued patent. In thus grounding its decision upon an evaluation of the difference between the process of the original patent and the process of the reissued patent in its purely technological aspect, the Court below departed from the rule of this Court that the intention of the patentee as it appears from the original patent is controlling.

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* The experts' testimony was characterized as being "from the technical viewpoint of chemistry," "from a scientific standpoint," or "speaking entirely as a chemist." (See Court of Appeals' opinion, R. Vol. II, pp. 180-1.)

The failure to accept this Court's interpretation of the statute led the lower Court into direct conflict with a group of decisions by this Court applying the principle of *Parker & Whipple* v. *Yale Clock Co.* to situations of identically the same nature as that presented here in which a patentee had attempted by reissue to make permissive a step described as mandatory in his original patent. Without exception these cases hold that the statutory requirement that a reissue must be "for the same invention" does not permit any step of a process, or any element of a device, made essential in an original patent to be made non-essential in a reissue. *Gill* v. *Wells*, 22 Wall. 1; *Collar Company* v. *Van Dusen*, 23 Wall. 530, 558; *Russell* v. *Dodge*, 93 U. S. 460; *Manufacturing Co.* v. *Ladd*, 102 U. S. 408, 413; *James* v. *Campbell*, 104 U. S. 356, 374; *Johnson* v. *Railroad Co.*, 105 U. S. 539; *McMurray* v. *Mallory*, 111 U. S. 97, 102; *Hoskin* v. *Fisher*, 125 U. S. 217, 222; *Cornell* v. *Weidner*, 127 U. S. 261, 264; *Farmers' Friend Mfg. Co.* v. *Challenge Corn-Planter Co.*, 128 U. S. 506; *Huber* v. *Nelson Mfg. Co.*, 148 U. S. 270; *Corbin Cabinet Lock Co.* v. *Eagle Lock Co.*, 150 U. S. 38, 42; *Olin* v. *Timken*, 155 U. S. 141, 146.

That rule has been applied by this Court in suits based on patents for processes, patents for manufactures, and patents for apparatus.

An instance of application of the rule in a suit on a process patent is *Russell* v. *Dodge*, 93 U. S. 460. There the original patent was for a process of treating bark-tanned skins by means of a compound in which *heated* fat liquor was explicitly made an essential ingredient. There was no disclosure that the fat liquor could be used cold. In the reissue, the specification was changed by eliminating the requirement that the fat liquor be in a heated condition. The Court held the reissue invalid, saying (p. 464):

> "The change made in the old specification, by eliminating the necessity of using the fat liquor in a heated condition, and making in the new specification its use in that condition a mere matter of convenience, and the insertion of an independent claim for the use of fat liquor in the treatment of leather generally, operated to enlarge the character and scope of the invention. The evident object of the patentee in seeking a reissue was not to correct any defects in specification or claim, but to change both, and thus obtain, in fact, a patent for a different invention. This result the law, as we have seen, does not permit."

An instance of application of the rule in a suit on a patent for a manufacture is *Collar Company* v. *Van Dusen*, 23 Wall. 530. There the original patent covered a shirt collar made of parchment-paper, or paper prepared with animal sizing, coated with a varnish of bleached shellac. There was no disclosure that the animal sizing could be omitted or that the varnish of bleached shellac could be dispensed with and yet the collar remain a useful and efficient article. The claims of the reissue patent, however, claimed a paper collar in which both the use of animal sizing and varnish were made permissive. The Court affirmed the dismissal of the bill, saying of the reissue patent (pp. 559-560):

> "Animal sizing, according to that patent, may be *used* or it may be *omitted*, and one or both sides of the paper may be covered with a thin varnish of bleached shellac or such a coating may be *omitted* altogether, which shows that those two requirements of the original patent are not a material part of the invention embodied in the reissued patent.
>
> Authorities to support the proposition that a reissued patent is invalid if not for the same invention as the surrendered original are scarcely neces-

sary as the rule is universally acknowledged." (Emphasis by the Court.)

Typical of many instances of application of the rule in suits on patents for apparatus is *Gill* v. *Wells*, 22 Wall. 1. There the original patent disclosed and claimed a machine for making hat bodies. One of the elements of the machine disclosed was a four-sided square tunnel or chamber interposed between the fur disintegrator and the rotating vacuum cone on which the hat body was formed. A current of air passing through this tunnel conveyed the fibres from the disintegrator brush to the cone. Nothing was said in the original specification to lead one to suppose that the tunnel could be dispensed with and yet the same result be obtained. The reissued patent claimed a machine from which the tunnel had been omitted. The Court held the reissue patent invalid. After pointing out that one who had fully described in his original specification several combinations of a varying number of elements, but had inadvertently failed to claim one of the described combinations, could remedy his mistake by reissue, the Court said (pp. 24-25):

> "Very different rules, however, apply in a case where the only invention described in the original patent is the one which includes all the ingredients of the machine, provided there is no suggestion, indication, or intimation that any other invention of any kind has been made. Such a patentee as the one last mentioned may subsequently discover that he can accomplish a new and useful result by a combination embracing less than the whole number of the ingredients included in the prior patented combination, but he cannot secure the right and privilege of a patentee in the combination of the smaller number of the ingredients by a surrender of his first patent and a reissue of the same which shall include the

second combination as well as the first, because the reissued patent in that event would not be for the same invention as the surrendered original."

And on page 26:

> "Patient search has been made in vain for any trace of the description of any other invention in the original patent than that of the combination of all the ingredients of the apparatus described by the patentee as the one used by him to effect the described patented result. Unable to discover in that specification any description of any other invention than that, the court is of the opinion that none other was secured by the original patent.
>
> *Argument to show that an invention consisting of a combination of three ingredients which are old is not the same as that of a combination of four old ingredients is quite unnecessary, as the negative of the proposition is as well settled in the patent law as it is in mathematics.*"

Another case in this same catagory is *Huber* v. *Nelson Mfg. Co.*, 148 U. S. 270. There the original patent was for a sanitary water-closet. In each of the six claims of the original patent and in the specification and drawing, a flushing chamber was included as an element of the combination defined. Although the original patent nowhere stated that the apparatus was operative in the absence of the flushing chamber, the specification of the reissue was altered to include a statement that the flushing chamber "has no function of its own," and claims were introduced to embrace a flushing apparatus like that covered by the claims of the original patent, *less* the flushing chamber. The Court held the statement that the flushing chamber "has no function of its own" to be "new matter," not suggested in the original patent, and sustained the defense

that the reissue was not for the same invention. The Court said (p. 291):

> "The entire text of the original specification shows nothing but the invention of a structure containing both a tank and a flushing-chamber. That chamber is referred to in the text of the original specification thirty-one times.
>
> We think that, on all the facts of this case, no one of the claims of the reissue can be construed as valid in leaving out the flushing-chamber as an element of the combination, inasmuch as every claim of the original patent contained it. *Prouty* v. *Ruggles*, 16 Pet. 336, 341; *Brookes* v. *Fiske*, 15 How. 212, 219; *Burr* v. *Duryee*, 1 Wall. 531; *Reckendorfer* v. *Faber*, 92 U. S. 347; *Fuller* v. *Yentzer*, 94 U. S. 288; *Railway Co.* v. *Sayles*, 97 U. S. 554; *Water-Meter Co.* v. *Desper*, 101 U. S. 332."

The lower courts have followed the interpretation of the Reissue Statute laid down by this Court. A list of cases is cited in the margin.* The representative case of *Featherstone* v. *George R. Bidwell Cycle Co.*, 57 Fed. 631, (C. C. A. 2) contains a particularly clear statement of the rule. That case involved a reissue patent for a bicycle tire.

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* *Featherstone* v. *George R. Bidwell Cycle Co.*, 57 Fed. 631 (C. C. A. 2d); *Toupet-Taylor Engineering Co.* v. *Red Dog Mfg. & Supply Co.*, 16 F. (2d) 454 (C. C. A. 3d); *Chicago Ry. Equipment Co.* v. *Perry Side Bearing Co.*, 170 Fed. 968 and 178 Fed. 449 (C. C. A. 7th); *McDowell* v. *Ideal Concrete Mach. Co.*, 187 Fed. 814 (C. C. A. 7th); *Penn Electric Switch Co.* v. *Luthe Hardware Co.*, 63 F. (2d) 842 (C. C. A. 8th); *Morgan* v. *Drake*, 36 F. (2d) 511 (C. C. P. A.); *Kollsman* v. *Carbonara*, 88 F. (2d) 966 (C. C. P. A.); *In Re Cogswell*, 48 F. (2d) 402 (C. C. P. A.); *In Re Williams*, 75 F. (2d) 520 (C. C. P. A.); *In Re French*, 89 F. (2d) 662 (C. C. P. A.); *In Re Overbury*, 95 F. (2d) 331 (C. C. P. A.).

In the specification and claims of the original patent certain "protective strips" were regarded as an essential part of the invention. In the reissue patent the claims were freed of this limitation. In considering the technological aspect of these strips the Court said (pp. 634-35):

> "It is obvious that the protective strips which are incorporated into the claim of the original patent, but which are omitted in the fourth claim of the reissue, are not an indispensable part of operative fastening devices for securing a pneumatic tire to the rim of the wheel. It is also obvious that they can be omitted from the fastening devices of Dunlop without rendering the other devices inoperative."

In spite of this finding that the strips were not a "vital, essential, substantial, material" element of the invention from a scientific point of view, the Court held the reissue patent invalid, saying (p. 636):

> "It has been repeatedly declared by the supreme court that a reissue cannot be permitted to secure any invention which was not described in the original patent; it is confined to securing one which was not only described, but which it was the intention of the patentee, manifest upon the face of the patent itself, to secure thereby. In other words, it must appear by the description in the original patent that it was the purpose of the patentee to secure the thing specified in the claim of the reissue, and a patent cannot be lawfully reissued unless there has been a clear mistake, inadvertently committed, in the wording of the claim."

The error of the Court below in holding that the difference between the process described and claimed in the original patent and the process described and claimed in the reissue must be ignored as immaterial because the final

result of the two processes is the same, is demonstrated by the cases just discussed. It is perfectly clear that in *Russell* v. *Dodge* the ultimate result of tanning the skins was accomplished whether the fat liquor was heated, as required by the original patent, or unheated, as disclosed in the reissue. Nevertheless, the Court held the reissue omitting this requirement to be void. Likewise, in *Huber* v. *Nelson*, the flushing chamber, claimed in the original patent in combination with the injector, was not in fact essential to its operation, the injector being able to perform its function as well with a single tank as with a tank and flushing chamber combined (148 U. S. 270, 289). Yet the reissue patent was held invalid. Similarly in *Gill* v. *Wells* the tunnel omitted in the reissue was not in fact necessary to the distribution of fur upon the revolving vacuum cone. But since the original patent contained no disclosure that it could be dispensed with (22 Wall. 1, 6) the reissue was declared void. In that case the Circuit Court fell into the same error as the Court below and its judgment of validity was reversed for the specific reason, among others (22 Wall. 1, 31):

> "That the Circuit Court erred in instructing the jury that the reissued patent is valid as respects the fourth claim if the combination of the three ingredients therein mentioned is new and could be usefully employed for the purpose of facilitating the making of hat-bodies * * * *if those three devices would make a hat-body without the aid of other means of protecting the fur against escape.*"

Without further specific example it is enough to point out that in all cases in which patents have been reissued to eliminate an element described as essential in the original patent, but which was in fact not essential, the results of the two processes or machines have always been substan-

tially the same. It is precisely because third parties can obtain or are obtaining the desired result without infringing the original patent that a reissue is obtained and suit is brought. Yet in every case of this kind brought to the attention of this Court the broadened reissue patent has been declared invalid as being not "for the same invention" as the original.

The point of all these decisions is that where a patentee asserts a step of a process as *mandatory,* as was found to be the fact here, he thereby makes it an essential part of his invention and a limitation on his monopoly. Having conceived the process as one in which that step is always to be taken and so informed the public in his original patent, he cannot thereafter reissue the patent to omit the step included in the original merely because afterthought or further investigation reveals that as a matter of scientific fact a similar result can be achieved even though the step be omitted.

The error of the Court below lay in failing to recognize from these cases that the difference between the two patents that has been held to be "vital, essential, substantial, material" under the statute is not the difference between the technological results obtained by the machines or processes disclosed, but is the difference in scope of the monopoly sought to be secured in the original patent and the monopoly asserted in the reissue.

This was also the error of the District Court, appearing very clearly in its Finding of Fact number 8 (R. Vol. I, p. 24; *supra,* p. 21) which was adopted by the Court of Appeals (R. Vol. II, p. 177). The statement in the District Court's opinion that "with respect to water, the specifica-

tions of the original patent are not essentially different from those in the reissued patent" (R. Vol. I, p. 9), and its Finding of Fact number 7, to the effect that "There is no variance" between the inventions described and claimed in the two patents (R. Vol. I, p. 24; *supra*, pp. 20-21), are somewhat obscure, as they appear to relate to the language of the patent rather than to the testimony of the experts. Nevertheless, they contain the germ of the same error, and were so interpreted by the Court of Appeals (R. Vol. II, p. 177).

The Court of Appeals assumed to find support for its decision in the case of *Seymour* v. *Osborne*, 11 Wall. 516 (R. Vol. II, p. 182). That case approves resort to the testimony of expert witnesses when the Court is determining, as a matter of construction, by comparison of the two instruments, whether the original and reissue patents are for the same invention. Such resort is approved for explanation of technical terms or terms of art in ascertaining the true meaning of the language employed. The Court of Appeals in the instant case did resort to the testimony of expert witnesses for that purpose (R. Vol. II, p. 176), and having done so, found without any hesitation that "*there is a difference* here in that the original patent contemplated the voluntary introduction of water into the reaction-chamber (distinguished from the mere formation of water during the course of the reactions) as a step that would always be taken in the procedure therein set out, while Claims #8 and #9 contain no such requirement, and indeed seem to negative clearly any such step" (R. Vol. II, p. 177).

The decision in *Seymour* v. *Osborne*, created no alteration in the established rule of this Court as to the proper

interpretation of the words "for the same invention" in the reissue statute.* That case does not in any way support the action of the Court of Appeals in the instant case in sustaining a reissue patent which, on the facts found by it, differs essentially from the original patent in respect to the scope asserted for its monopoly, merely because it has been established by expert testimony that the original limitation to the voluntary addition of water is not in fact essential to obtaining the desired result.

## General Considerations

In the final section of the opinion of the Court below entitled "General Considerations," the Court asserts that the defenses set up by petitioner, including this defense that the reissue patent is not for the same invention as the original patent, are "terribly technical in the extreme" and "contain little or no appeal to the beneficent principles of equity and good conscience" (R. Vol. II, p. 186).

We submit that exactly the contrary is true.

The rule so long established and so consistently observed by this Court finds its origin in a determination to protect from abuse the beneficent purposes of the reissue statute; to preserve to the patentee, who has by inadvertence, accident or mistake, obtained a patent that is inoperative or insufficient to cover what he intended to claim as his invention, the right to correct his mistake by subsequent reissue, while at the same time guarding against any abuse of that privilege by which the monopoly originally contemplated

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* See this Court's comment on *Seymour* v. *Osborne* in *Parker & Whipple Co.* v. *Yale Clock Co.*, 123 U. S. 87 at p. 97.

is artificially enlarged. It is a just rule calculated to prevent a situation in which legitimate industry is subjected to hidden liens and unknown liability to vexatious lawsuits.

The reissue statute is a remedial and permissive statute. It extends to the patentee the unusual privilege of modifying his contract with the public to correct bona fide mistakes which have caused his assertion of monopoly to fall short of what he intended to claim. The requirement of the statute that the reissue be "for the same invention" is a fundamental statutory limitation upon this privilege, intended and well adapted, as it has been interpreted by this Court, to prevent abuse of the privilege. It is this restriction that separates the good from the bad, allowing the just claims of the inventor who has failed by inadvertence, accident or mistake to secure his intended monopoly, while barring the unjust claims of a patentee who seeks to extend his monopoly to cover discoveries, improvements, or developments which were not within his knowledge at the date of his application* or to which, if within his

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*In the instant case the evidence tends to establish that at the time of his original U. S. application, Lefort was not aware that the introduction of water could be dispensed with. The third of the series of French patents applied for prior to the U. S. application, and upon which the original U. S. application was based, makes specific claim to the *"necessity of introducing water vapor into the reacting gases"* to obtain ethylene oxide (R. Vol. I, pp. 371, 373). No change from this conception appears in the subsequent French patents until a year and a half after the U. S. patent had been applied for, when on July 10, 1933, the French company applied for a French patent directed to the discovery that *the introduction of water to the reacting gases could be dispensed with* (R. Vol. I, pp. 439, 440). It was not until after this French patent had been granted that application for reissue of the U. S. patent was filed by respondent.

knowledge at that time, he made no public assertion of right by disclosure and attempt to claim in his original patent.

That limitation imposed upon the remedial provisions of the reissue statute has most assuredly appealed to the "equity and good conscience" of this Court over a long period of years.

The Court below, on the basis of the considerations which it has set forth in its opinion and which we have discussed, has seen fit to attempt a breach in the well-established rule; to open therethrough a passage toward what the Court believed to be equity and good conscience, on evidence that in a scientific sense the newly monopolized process of the broadened claims is not different vitally, essentially, substantially or materially from the process monopolized by the original claims because the new process produces the same technological result as the old. We submit that through such a breach all of the evils which this Court has tried to shut out would pour. It is precisely because industry must remain free to produce by other processes the technological results of a patented process, that the rule has been adopted and enforced.

**2. Petitioner has acquired intervening rights which render it inequitable to enforce against it the enlarged monopoly defined by claims 8 and 9 of the reissue.**

One of the most vexing questions raised by the grant of reissue patents with broadened claims relates to the rights of innocent parties who, respecting the monopoly of an original patent, have evolved a non-infringing process or device only to find themselves subsequently in the position of infringers by reason of the unexpected appearance of a reissue with claims of broader scope than those of the original patent.

The inequity of this situation was early recognized in the law of reissue. Thus, in the case of *Miller* v. *Brass Company*, 104 U. S. 350, 355, it was pointed out that

> "* * * the evils which have grown from the practice [broadened reissues] have assumed large proportions. Patents have been so expanded and idealized, years after their first issue, that hundreds and thousands of mechanics and manufacturers, who had just reason to suppose that the field of action was open, have been obliged to discontinue their employments, or to pay an enormous tax for continuing them."

Again, in the case of *Dunham* v. *Dennison*, 154 U. S. 103, the Court, speaking through Mr. Justice GRAY, said at page 110:

> "The patentee thus gave the public to understand that an envelope, the flap of which did not cover its whole length, would not come within his patent, and might rightfully be made by anyone. After the defendant had made envelopes with a short flap of semicircular shape and covering little more than the opening of the envelope, (which, it is admitted, did not infringe the plaintiff's patent as originally issued,) the plaintiff obtained a reissue, enlarging the claims, and altering the specification throughout, so as to include an envelope with a flap of any size or shape, and to make the invention consist, not, as in the leading words of the description in the original patent, of 'an envelope with an end flap covering its side,' but in 'a tag provided with means for attaching it to the merchandise, and with an envelope or pocket to receive a bill or invoice of the merchandise.' The words of the description in the original patent were neither technical nor complicated; but they were of the simplest kind, and their meaning and scope could not have been misunderstood by anyone who read them with the slightest attention, least of all by the patentee. To uphold such a reissue under such circumstances would be to grant a new and distinct

privilege to the patentee at the expense of innocent parties, and would be inconsistent with the whole course of recent decisions in this court.' (Parenthesis by the Court.)

In these and in similar early cases, the reissued patents were held invalid on other grounds, the intervenor's plight being advanced as emphasizing the harmfulness of broadened reissues rather than as an ultimate ground of decision.

The question of intervening rights in connection with reissued patents was recognized by this Court as raising an important question of patent law which had not been but should be determined in *Keller* v. *Adams-Campbell Co.*, 264 U. S. 314, but no decision on the issue of intervening rights was rendered in that case.

Quite recently the issue of intervening rights came before the Court again in *Sontag Chain Stores Co.* v. *National Nut Co.*, 310 U. S. 281. In that case, this Court decided that where it appears that the defendant in a suit for infringement of a reissued patent began commercial use of the accused process or machine prior to the date of application for the reissued patent, then intervening rights accrue to him and injunctive relief against him should be denied the patent owner. The decision in that case was limited to the scope indicated. Being so limited, it left undecided by this Court whether or not intervening rights accrue to one who fully and completely develops a process or apparatus by prolonged and expensive research carried on prior to the grant of reissue, but does not initiate commercial operation until after the grant of the reissue. That question has never been decided by this Court.

In the instant case, petitioner's accused process was independently developed by petitioner's research engineers

in petitioner's own laboratories. The development of petitioner's process was completed and application for a patent covering inventions made in the course of the work was filed on May 8, 1937, a date prior to the grant of the reissue (R. Vol. I, pp. 224-5). The total expenditures of petitioner upon the development work from its inception to September 25, 1936, the date upon which the reissue application was filed, was approximately $132,000. Between September 25, 1936, and May 18, 1937, the date upon which the reissue was granted, an additional $19,000 was expended (R. Vol. I, p. 226). Throughout this development period, petitioner's technicians in charge of the research received and examined all pertinent literature as it was published, including the several French patents referred to in the foregoing and the original U. S. patent on which the reissue in suit is based (R. Vol. I, pp. 223; 196). That original U. S. Patent was granted April 23, 1935, so from that date on the research and development work was conducted with knowledge of the limitations of the monopoly of that patent.

The process so evolved by petitioner is not within the description of the original patent nor the claims of that patent, but it is within the description of the reissue patent and it is within the broader claims 8 and 9 added by the reissue. Nevertheless, the courts below refused to recognize petitioner's intervening rights on the ground that the work done before the reissue was granted was limited to experimental and development work (R. Vol. II, pp. 185-6).

In principle there appears to be no reasonable distinction to be drawn between the rights acquired by one who has made actual commercial use of a non-infringing device or process in reliance upon the limitations of an original patent, and one who, in the same reliance, has himself invented and perfected a non-infringing device or process. To deprive

the latter of the right to put the process so developed into commercial use deprives him of the fruits of his initiative as surely as to prevent an intervening manufacturer from continuing the use of the process or machinery he has installed in his factory. The inventor of a non-infringing process is in even worse case than the commercial user insofar as losses are concerned, for the user has at least obtained the benefits of his use prior to the reissue while the inventor must write off as a total loss the time, money, and energy invested in his development work if he is forbidden to seek any commercial return upon it. And certainly the expenditures in research and development work of the intervening inventor comprise vested interests of as positive a character as the commercial expenditures of the intervening manufacturer.

The issue stated in the foregoing was considered by the Court of Appeals for the Second Circuit in *Otis Elevator Company* v. *Atlantic Elevator Company*, 47 F. (2d) 545. In that case the court discussed the effect of experimental and development work carried on by the defendant between the date of the original patent and the broadened reissue thereof. With respect to the situation presented to it, the Court said (p. 548):

> "The installations at Los Angeles, Chicago and Pittsburgh were, it is true, experiments, and did not go into permanent operation, but they were steps forward. They involved considerable expense, whose fruition came later in the building at Cleveland, completed before the application was filed. We should not ignore them, because they were not used; the analogy of a prior use as anticipation is not apt. The question, on any view, is of the conflicting interests involved; the patentee's, to extend his monopoly; the public's, to be protected in vested rights acquired meanwhile. Earlier experiments, involv-

> ing large expense, and being the first steps in a continuous development which ends in a completed apparatus, are fairly to be taken as vested interests."

Although this *Otis* decision appears to be the only one relating directly to the question here presented, this Court, in the *Sontag* case, indicated that in approving the rule of intervening rights developed by the lower courts it had in mind not only the rights of the intervening manufacturer, but of the intervening inventor as well. Thus the Court said (pp. 293-4):

> "Recapture within two years of what a patentee dedicates to the public through omission is permissible under specified conditions, but not, we think, 'at the expense of innocent parties.' Otherwise, the door is open for gross injustice to *alert inventors* and baffling uncertainty will hinder orderly development of useful arts."

This statement is particularly apt in view of the modern industrial background of invention. The Court can take judicial notice of the fact that a large proportion of the industrial improvements developed in recent years has evolved from protracted research conducted at great expense. The ultimate object of such research is not merely to produce patentable inventions, but to employ those inventions in commercial operations. Under these conditions, where extensive development work of an experimental nature involving years of time and large expenditures of money necessarily precedes commercial operations, the restriction of intervening rights to those alone who have actually reached the stage of commercial operation prior to the reissue would work great harm. In any field in which there existed a patent which could conceivably be reissued with an enlarged monopoly, the risk involved

in financing further research and development work would create an overpowering obstacle to "alert inventors." With no prospect of protection against enlarged reissues until after the invention has been put into commercial operation, a step which involves a cost far greater than that required for the development work itself,* the risk of loss becomes entirely disproportionate to the opportunity for profit, and the progress of science and useful arts in that field is correspondingly delayed. It is only by recognizing the expenditure of time, effort, and money in the development work itself that the tremendous modern investment in research and development of improved industrial processes, upon which the progress of modern industry so largely depends, can be secured and protected.

## Industrial Importance of the Lefort Process

The Court of Appeals laid considerable emphasis upon the industrial importance of the direct oxidation process. The Court said that a French inventor "made a discovery of great scientific importance and unquestioned commercial value" resulting in a process which "provided a practical and original solution to a problem that had long baffled industrial chemists" (R. Vol. II, p. 186).

It is clear that although such considerations have a legitimate bearing on questions of patentability, they cannot properly affect the determination of the questions of reissue law presented by this case. The lower Court's opinion, nevertheless, does reveal fairly plainly that it was influenced by sympathy for the patent even in its interpretation of the reissue statute. This sympathy was

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* Petitioner's Baltimore plant cost more than $1,000,000 (District Court's opinion, R. Vol. I, p. 20).

misplaced factually, as well as legally. In point of fact the evidence of the record does not support the contention of industrial importance which influenced the Court.

Respondent offered no evidence of anything done by the patentee or the French company in practicing the process described in the original patent and no evidence of any commercial achievement in utilizing that process. Such evidence as there is in the record was offered by petitioner and indicates that the process of the original patent is not useful commercially (Pyzel, R. Vol. I, pp. 32-70; de Jong, R. Vol. I, pp. 70-89; Deft's. Exs. 42-3, 46-61, 64, R. Vol. I, pp. 385-426).

Petitioner's process and that of the respondent, two processes developed in the United States each independently of the other, are processes which are important and have "unquestioned commercial value." *Those two processes do not involve the introduction of water into the reaction chamber along with the ethylene and air.* Therefore, neither of those processes is the process of the original patent. They are different processes which are within the reissue specification and within the broader claims of the reissue only because of the respects in which the specification and claims of the reissue are different from the specification and claims of the original patent.

These being the facts as disclosed by the record, it is wholly illusory to find importance and value in the process described in the original patent by reason of any measure of success attained by petitioner and respondent in the use of their different processes.

An analogous situation has been the subject of comment by this Court quite recently in the concurring opinion of the Chief Justice in *Cuno Engineering Corporation* v. *Automatic Devices Corporation*, 86 L. Ed. 21; 51 U. S. P. Q. 272.

In that case the commercially successful device for which the respondent claimed credit was not the device described in the patent in suit and the Court pointed out that consequently any favorable deduction which might be drawn from such success could not apply to the patent under consideration. Here the Court of Appeals appears to have found some justification for the enlargement of the monopoly of the original patent by reissue because of the success of a process which is not that described in the original patent and is within the description of the reissue only by reason of the changes in the description made in the process of reissuing. That proposition can be accepted no more readily than the respondent's claims in the *Cuno* case.

## Conclusion

We submit that the record here discloses a plain case of error of the lower courts and that the error should be rectified by remanding the case with instructions to enter a decree holding the two broadened claims of the reissue patent to be invalid, and further that if they were valid this petitioner should be free to use the process which it developed at great expense prior to the grant of the reissue.

Respectfully submitted,

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Dated: February 11, 1942.

# APPENDIX

## Reissue Statute

R. S., SEC. 4916. (U. S. C., Title 35, Sec. 64.) Whenever any patent is wholly or partially inoperative or invalid, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new, if the error has arisen by inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, the commissioner shall, on the surrender of such patent and the payment of the duty required by law, cause a patent for the same invention, and in accordance with the corrected specification, to be reissued to the patentee or to his assigns or legal representatives, for the unexpired part of the term of the original patent. Such surrender shall take effect upon the issue of the reissued patent, but in so far as the claims of the original and reissued patents are identical, such surrender shall not affect any action then pending nor abate any cause of action then existing, and the reissued patent to the extent that its claims are identical with the original patent shall constitute a continuation thereof and have effect continuously from the date of the original patent. The commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the thing patented, upon demand of the applicant, and upon payment of the required fee for a reissue for each of such reissued letters patent. The specifications and claims in every such case shall be subject to revision and restriction in the same manner as original applications are. Every patent so reissued, together with the corrected specifications, shall have the same effect and operation in law, on

the trial of all actions for causes thereafter arising, as if the same had been originally filed in such corrected form; but no new matter shall be introduced into the specification, nor in the case of a machine patent shall the model or drawings be amended, except each by the other; but when there is neither model nor drawing, amendments may be made upon proof satisfactory to the commissioner that such new matter or amendment was a part of the original invention, and was omitted from the specification by inadvertence, accident, or mistake, as aforesaid.

Patented Apr. 23, 1935

1,998,878

# UNITED STATES PATENT OFFICE

1,998,878

## PROCESS FOR THE PRODUCTION OF ETHYLENE OXIDE

Théodore Emile Lefort, Paris, France, assignor to Société Anonyme; Societe Francaise de Catalyse Generalisee, Paris, France

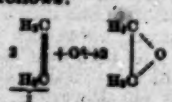
No Drawing. Application March 22, 1932, Serial No. 600,578. In France March 27, 1931

7 Claims. (Cl. 260—156.5)

REISSUED

This invention has for object a process for the production of ethylene oxide which mainly consists in subjecting ethylene to the simultaneous action of the oxygen of air and of water, in presence of a catalyzer and, if need be, of hydrogen.

Hydrogen, in case it is employed, in contact with the catalyzer, probably plays the part of an agent for accelerating the reaction which can be written as follows:



This reaction takes place at atmospheric pressure but, for commercially carrying the said process into practice, pressure can be employed, for instance a pressure of 50 kilograms per square centimeter, at a temperature between 150 and 400° C.

The following catalysers may be used:

(1) A mixture of antimony, bismuth, silver, lead, arsenic, nickel and tin, in variable proportions.

(2) Silver alone.

(3) Silver activated by introducing therein small proportions of gold, copper or iron.

(4) The metals: gold, copper, iron, separately or in admixture and in any proportions.

(5) Silver alone, bismuth alone and antimony alone.

(6) The following mixtures:

| | |
|---|---|
| Silver, gold, copper, iron | in any proportions |
| Silver, gold, copper | |
| Silver, gold | |
| Silver, copper, iron | |
| Silver, copper | |
| Silver, iron | |
| Copper, iron | |

(7) The mixtures of antimony, lead, nickel and silver.

(8) The mixtures of bismuth, nickel, silver and lead.

(9) The mixtures of antimony, bismuth, nickel.

(10) The mixtures of antimony, bismuth, silver.

(11) The mixtures of bismuth and nickel.

(12) The mixtures of bismuth and silver.

And, generally speaking, all the mixtures which can be obtained with the following metals: antimony, lead, bismuth, silver, nickel, tin, arsenic, gold, copper, iron, taken separately, taken two by two, three by three, four by four, etc. . . . in variable proportions, the mixtures, in the same conditions, of these metals with their oxides, the mixtures of the oxides alone of these metals, in the same conditions.

The ethylene can be obtained from any source of supply: gas from coke ovens, hydrogenation of acetylene, dehydration of ethyl alcohol, and the like.

Water can be admitted in the reaction vessel, either in the liquid state, or as steam.

The oxygen can be the oxygen of the air, this latter gas being introduced in the reaction.

The efficiency of the reaction is increased by diminishing the $CO_2$ which is formed, by introduction, in this reaction, of a suitable quantity of water. A suitable volume of $CO_2$ can also be previously introduced in the reacting gases.

For increasing the yield in ethylene oxide, the process can also be carried out under a pressure lower than atmospheric pressure.

Experiments have shown that silver could be activated by introducing, in this body, small quantities either of gold, or of copper, or of iron.

Thus, a mixture containing silver, gold, copper and iron, gives very satisfactory results and allows a specific reaction; the only foreign product obtained in the reaction is $CO_2$ which can be easily removed. Aldehydes formed exist only as traces.

Moreover, the applicant has found that the reaction giving $CO_2$ is, contrarily to previous belief, a reaction of oxidation independent from that giving ethylene oxide and from that giving aldehydes. From experiments effected by the applicant, it results that, if water is introduced in suitable quantity, the reaction is not only facilitated, as above stated, but, in addition, the reaction giving $CO_2$, probably by direct oxidation of ethylene according to the equation:

$$C_2H_4+3O_2=2H_2O+2CO_2$$

is checked, owing, as is probable, to the partial pressure of water. From these experiments, it can be concluded that if a certain quantity of $CO_2$ is previously introduced, in addition, in the reacting gases, the partial pressure of $CO_2$ will produce its effect, and the reaction of oxidation of ethylene into $CO_2$ will be completely checked resulting in a considerable increase in the efficiency of the operation. Moreover, it is to be noted that, when the synthetic operation is effected under partial vacuum, the yield in ethylene oxide is increased.

Several modi operandi for carrying the process

into practice, will be indicated hereinafter, by way of example only.

*Modus operandi I*

In a plant constructed for resisting to high pressures, ethylene on the one hand, and air on the other hand, are separately compressed by means of suitable compressors.

The mixture of air and ethylene can also be compressed by taking the necessary precautions in order to avoid the risk of explosion.

These two gases will be led, together with hydrogen or not, into a reaction tube resisting to the pressure of several hundreds of kilograms, containing one of the catalyzers indicated above, and heated, for instance, to a temperature of 200° C. This tube communicated moreover with a circulating pump allowing to introduce water under pressure.

The reaction will take place in this tube between ethylene, the oxygen of air, and water. By controlling the outputs, a continuous operation will be obtained. Ethylene oxide thus formed will be separated from the other gases, for instance, by condensation.

*Modus operandi II*

Silver in powder form, or in the form of a wire ...ure, and placed or not on a support or carrier, is introduced in a tube, made for instance of silica, and, after the said tube has been heated to a temperature comprised between 150 and 400° C., a mixture of ethylene, air, water vapour, and hydrogen is caused to pass therethrough. The proportion of hydrogen is about 5% of the total mixture. The ethylene oxide produced can be separated from the gases issuing from the tube.

*Modus operandi III*

A silver colloid is introduced in a high pressure tube which has been filled with water. Pure ethylene under pressure is then added in order that it can dissolve in the water.

The tube is subsequently heated between 150 and 400° C., then air and hydrogen are slowly introduced. The introduction of air is stopped when the totality of ethylene is converted into ethylene oxide.

From ethylene oxide produced according to the processes which have been indicated above, it is possible to obtain, by simple saponification, ethylene-glycol, or by other known methods, any derivative of ethylene-glycol.

The reaction, for obtaining ethylene-glycol, can be written as follows:

$$C_2H_4O + H_2O \rightarrow \begin{matrix} H_2C-OH \\ | \\ H_2C-OH \end{matrix}$$

The experiments effected by the applicant have shown that, in presence of the catalyzers indicated, water, in the form of steam or not, considerably promotes the reaction ensuring the production of ethylene oxide.

What I claim as my invention and desire to secure by Letters Patent is:

1. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen and water, in presence of a catalyst, constituted by silver activated by introducing in the body small quantities of a metal selected from a group consisting of gold, copper, and iron, at a temperature between 150 and 400° C.

2. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of the oxygen and water, in presence of a catalyst, constituted by a mixture of silver, gold, copper and iron, at a temperature between 150 and 400 degrees C.

3. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen and water, in presence of a catalyst constituted by a mixture of silver and gold, at a temperature between 150 and 400° C.

4. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen and steam, in presence of a catalyst constituted by a metal selected from a group consisting of silver, gold, copper and iron, and hydrogen in the proportion of 5 per cent of the total volume, at a temperature between 150 and 400 degrees C., and at a pressure below atmospheric pressure.

5. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen and steam, in presence of a catalyst constituted by a metal selected from a group consisting of silver, gold, copper and iron, and hydrogen in the proportion of 5 per cent of the total volume, and $CO_2$, and at a pressure below atmospheric pressure.

6. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen, steam and hydrogen in presence of a catalyst constituted by silver activated with small quantities of gold, at a temperature between 150 and 400 degrees C.

7. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen, steam and hydrogen in presence of a catalyst constituted by silver activated with small quantities of a mixture of gold and copper at a temperature between 150 and 400 degrees C.

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## PROCESS FOR THE PRODUCTION OF ETHYLENE OXIDE

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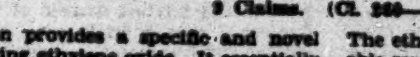
9 Claims. (Cl. 260—54)

This invention provides a specific and novel process for making ethylene oxide. It essentially consists in causing ethylene to combine directly with molecular oxygen at temperatures of about 150° to about 400° C. in the presence of a surface catalyst which favors the oxidation of ethylene to ethylene oxide under these conditions. The process can be carried out at atmospheric pressure, and it may also be conducted at pressures above or below atmospheric pressure.

This process is characterized by an entirely unique reaction in which the direct addition of a single oxygen atom to the ethylene molecule occurs without the formation of significant amounts of other oxygenated compounds such as aldehydes. This novel reaction may be expressed as:



and it is accompanied by complete oxidation of some of the ethylene to give carbon dioxide and water according to the equation:

$$CH_2{=}CH_2 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

Ethylene from any desired source may be used, including that obtained from coke oven gas, hydrogenation of acetylene, or dehydration of ethyl alcohol. The oxygen can be the oxygen of the air, and can conveniently be mixed with the ethylene prior to the reaction.

The oxidation of ethylene takes place with a giving off of heat, and it is, of course, desirable to maintain the temperature of the zone of reaction within the range specified. This can be facilitated by suitable dilution of the reaction gases, such as that accomplished by the use of air as the source of oxygen, and some water or carbon dioxide in addition to that formed can be admitted to the mixture in the reaction zone if desired. Hydrogen may be similarly added.

The process can be conveniently conducted by passing a mixture containing air and ethylene through a tube, for example, of silica or of a material capable of withstanding high pressures, within which is placed such a surface catalyst as one composed of silver in finely divided form, and which may be disposed within the tube on a supporting material, or in other known ways. The temperature of the reaction zone is maintained between about 150° and about 400° C., for example, at about 200° C., and the issuing products from the tube contain ethylene oxide, carbon dioxide and water without objectionable aldehydes.

The ethylene oxide can be recovered in any suitable way, preferably in liquid form by condensation or solution.

The surface catalyst is preferably silver as stated, but other metals such as bismuth and antimony may be used. Likewise oxides of these metals or mixtures containing these metals or their oxides may be used. Experiments have also indicated that the catalyst may be silver activated by the addition of small amounts of gold or copper or iron.

In any case, the ethylene and oxygen are thus reacted simultaneously at the temperatures set forth in the presence of a surface catalyst and of water, and the process is conducted to produce ethylene oxide as a direct product in substantial and economic amount. The ethylene oxide can be recovered by known methods, and it may be further reacted to form ethylene glycol or derivatives of ethylene glycol.

I claim:

1. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen and water at a temperature between 150° and 400° C. in the presence of a catalyst composed of silver activated by small quantities of a metal selected from a group consisting of gold, copper and iron.

2. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of the oxygen and water at a temperature between 150° and 400° C. in the presence of a catalyst composed of a mixture of silver, gold, copper and iron.

3. A process for the production of ethylene oxide, consisting in subjecting ethylene to the simultaneous action of oxygen and water at a temperature between 150° C. and 400° C. in the presence of a catalyst composed of a mixture of silver and gold.

4. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen and steam at a temperature between 150° and 400° C., and at a pressure below atmospheric pressure, in the presence of a catalyst composed of a metal selected from a group consisting of silver, gold, copper and iron, and in the presence of hydrogen in the proportion of 5 per cent of the total volume.

5. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen and steam at a pressure below atmospheric pressure, in the presence of a catalyst composed of a metal selected from a group consisting of silver, gold, copper

and iron, and in the presence of hydrogen in the proportion of 5 per cent of the total volume, and of $CO_2$.

6. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen, steam and hydrogen at a temperature between 150° and 400° C. in the presence of a catalyst composed of silver activated with small quantities of gold.

7. A process for the production of ethylene oxide consisting in subjecting ethylene to the simultaneous action of oxygen, steam and hydrogen at a temperature between 150° and 400° C. in the presence of a catalyst composed of silver activated with small quantities of a mixture of gold and copper.

8. The process of making ethylene oxide by the direct chemical combination of oxygen with ethylene in the proportions of one atom of oxygen to one molecule of ethylene, which comprises forming a mixture containing ethylene and molecular oxygen and conducting said mixture through a confined reaction zone which is maintained at an elevated temperature; controlling said temperature to maintain said mixture in said zone at a temperature between about 150° and about 400° C.; subjecting said mixture in said zone at said elevated controlled temperature to intimate contact with an active surface catalyst of a material having the catalytic characteristics of silver which favors the direct oxidation of said ethylene in said mixture by said molecular oxygen to form oxidation products containing ethylene oxide in the presence of water and which does not favor the existence in said products of substantial amounts of aldehydes; correlating the passage of said mixture through said reaction zone in the presence of said catalyst and the controlled elevated temperature of said mixture and said catalyst to effect said oxidation of said ethylene directly to form substantial amounts of ethylene oxide; and thereafter recovering ethylene oxide-containing product in liquid form.

9. The process of making ethylene oxide by the direct chemical combination of oxygen with ethylene in the proportions of one atom of oxygen to one molecule of ethylene, which comprises forming a mixture containing ethylene and molecular oxygen and a heat-absorbing diluent and conducting said mixture through a confined reaction zone which is maintained at an elevated temperature; controlling said temperature to maintain said mixture in said zone at a temperature between about 150° and about 400° C.; subjecting said mixture at said elevated controlled temperature to intimate contact with an active surface catalyst material composed essentially of silver which favors the direct oxidation of said ethylene in said mixture by said molecular oxygen to form oxidation products containing ethylene oxide in the presence of water and which does not favor the existence in said products of substantial amounts of aldehydes; correlating the passage of said mixture through said reaction zone in the presence of said catalyst and the controlled elevated temperature of said mixture and said catalyst to effect said oxidation of said ethylene directly to form substantial amounts of ethylene oxide; and thereafter separating ethylene oxide from the products of oxidation.

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